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ALCHEMICAL EQUIPMENT IN THE ELEVENTH CENTURY, A.D.,

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(WITH ONE PLATE.)

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NOTICE TO BINDERS.

By an oversight of the press Plate I has been reckoned as pp. 71-72. These numbers, therefore, do not occur in the paging of Vol. I.

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Alchemical Equipment in the Eleventh Century, A.D.

(With one plate).

By H. E. Stapleton, B.A., B.Sc., (Oxon), *Indian Educational Service*, and R. F. Azo, *Instructor in Arabic, Board of Examiners' Office, Fort William.*

[Read August 2nd, 1905.]

Contents.

	Page
I. Introduction	47
II. Analysis of the *'Ainu-ṣ-Ṣan'ah*	51
III. Arabic Text	65

Introduction.

In another paper [1] by one of the authors a list is given of the commoner substances that were employed by Greek alchemists of the 3rd century A.D. in their experiments on the preparation of gold and silver. The main object in inserting this list was to emphasise the absence of the particular substance whose history was being dealt with; but a secondary reason for its compilation was the discovery that the writer had just made of the treatise that will now be described. As this treatise summarises the equipment of a Persian alchemist in the first half of the 11th century, the present paper and the earlier portion of the preceding paper may be regarded as largely interdependent, each forming a commentary on the other.

The present treatise is entitled عين الصنعة وعون الصنعة *'Ainu-ṣ-Ṣan'ah wa 'Aunu-ṣ-Ṣana'ah* (Essence of the Art and Aid to the Workers) and was written at Baghdād in the year 426 A.H. (= 1034 A.D.) by one Abu-l-Ḥakīm Muḥammad ibn 'Abdil-l-Malik aṣ-Ṣālihī al-Khwārazmī al-Kāthī for his patron Ar-Ra'īs Abu-l-Ḥasan 'Alī ibn 'Abdillah. Neither author nor patron seems to be alluded to in the ordinary biographical sources of reference,[2] but a study of the contents of the treatise makes it clear that there can be little doubt as to the accuracy of the date mentioned. The florid style of the author's Introduction, with its ten poetical quotations in less than three and a half pages, is typical of the loss in simplicity that characterises Arabic writings of the 10th and 11th centuries, while the verses that occur at the beginning of Chapter I are completely parallelled by an extract from the works of Abū Aḥmad ibn Abī Bakr al-Kātib (*c.* 925 A.D.; cf. *postea*, p. 50, note (2)), quoted in Tha'ālibī's *Yatīmatu-d-Dahr*. The chief argument, however, in support of the date is the fact that the *'Ainu-ṣ-Ṣan'ah* can be annotated, in all its essential points, from five contemporary sources of alchemical information. These are (*a*) the *Rasā'il* of the *Ikhwānu-ṣ-Ṣafā'* ('Brethren of Purity'), written *c.* 970 A.D.; (*b*) the *Fihrist* of Ibn Abī Ya'qūb an-Nadīm, written 988 A.D.; (*c*) the second volume (on Drugs) of the *Qānūn* of Ibn Sīnā (Avicenna), written *c.* 1021; (*d*) two Syrio-Arabic treatises now in the British

[1] *Memoirs* A.S.B. I, pp. 25-41.

[2] *E.g.*, Tha'ālibī, Yāqūt, Ibnu-l-Athīr, Ibn Abī Uṣaibi'ah, Ibn Khallikān, Ḥājī Khalfa, and Brockelmann.

Museum, that were edited and translated by Duval, and published in Vol. II of Berthelot's *La Chimie au Moyen Âge*; and (*e*) the 10th Section of the *Mafātīḥu-l-'Ulūm* of Al-Khwārazmī, written *c.* 976 A.D.

The last-named author may indeed be the Qāḍhī Abū 'Umar al-Khwārazmī mentioned in the short list of alchemical experts that is given at the end of the Introduction to the *'Ainu-ṣ-Ṣan'ah*. This list, which mentions no alchemist later than the 10th century, also contains a name, Andria al-Ḥakīm, that only seems to occur elsewhere in the alchemical section of the *Fihrist*.

The present treatise forms part of a MS. volume of alchemical essays in the Library of His Highness the Nawab of Rampur, and from the colophons at the end of some of the other treatises in the volume, the original MS. seems to have been mainly the work of a copyist travelling in Armenia (*e.g.*, to the town of Sīwās) and Mesopotamia (Baghdād and Mosul) in 1283 A.D. (682 A.H.). The following may be quoted as an example:—

تيسر الفراغ بمدينة السلام منتصف شوال سنة اثنتين وثمانين وستمئة على يد محمد بن ابي الفتح بن ابي منصور بن محمد الكاشي غفر الله له ولوالديه

„ Finished at Madīnatu-s-Salām in the middle of *Shawwāl* in the year 682, by the hand of Muḥammad ibn Abi-l-Fatḥ ibn Abī Manṣūr ibn Muḥammad al-Kāshī. May God pardon him and his parents!"

The volume, however, has suffered much damage from replacement, and probably no part of the MS., as we now find it, is earlier than the 15th century.[1] About half the book—the older portion—is written in a clear *Naskhī* hand, while the remainder, which is interpolated in the middle of the *Naskhī*, is in *Nasta'līq*.

From the fragment of an index, it is evident that our treatise was originally followed by four other alchemical pamphlets, but these have all disappeared and the *'Ainu-ṣ-Ṣan'ah* now occupies the last 19 pages of the MS. It is unfortunately incomplete, the sixth and seventh chapters, together with a portion of the fifth, being missing; but even in its mutilated state, it forms a welcome addition to our previous knowledge of alchemical methods and equipment in the 11th century. Owing to the incompleteness of the treatise, nothing more than an analytical translation has been attempted; but this has enabled much of the superfluous matter in the Introduction and subsequent chapters to be removed. The corresponding Arabic text will be found at the end of the Analysis.

Special attention may be drawn to two points in connexion with the *'Ainu-ṣ-Ṣan'ah*. The first is the evidence supplied by Chapters III and IV of the great importance that was attached to weights in chemical operations 700 years before the time of Black and Lavoisier. The second is the remarkable similarity that has been observed between the drawings and description of the *Uthāl* (Aludel) and its furnace, as given on the last page of the Rampur MS., with those contained in the *Summa Perfectionis Magisterii* of the author whom M. Berthelot terms the Latin Jābir. So striking indeed is the resemblance between the two that we feel compelled to add a few words of criticism regarding M. Berthelot's

[1] Dr. Ross, of the Calcutta Madrasah, has been good enough to examine the volume for us, and confirms this date.

belief in the recent origin of the alchemical knowledge current in Europe during the 13th century.

To explain our meaning, we will quote two references to the Aludel that are to be found on pp. 565 and 569 respectively of the edition of the *Summa* that appeared at Basle in 1572 under the title *Artis Chemicae Principes*. Of the three figures, Nos. 1 and 3 are illustrations of a copy of the *Summa* that exists in Latin MS. No. 6514 of the Bibliothèque Nationale (written *c.* 1300 A.D.);[1] while No. 2—that of the furnace alone—is reprinted for purposes of comparison from the Basle edition of the *Summa*.

" Si igitur volueris multam sublimationis quantitatem elevare, tunc vas aludel tantæ capacitatis invenias, quòd illam suscipiat super fundum, ad elevationem unius palmæ. Ad illud coaptes furnum ut suscipiat aludel in medio sui cum distantia parietum suorum per duos digitos. Et furno facto, facies illi X.[2] auriculas, æquè distantes proportione una, ut una æqualitas sit ignis ad omnes partes illius. Tunc verò stipite ferreo in medio fornacis ex transverso in spondilibus ejus firmato, qui à fundo fornacis distet ad extensionem unius palmæ cum pollice suo, et ad spissitudinem unius digiti, super eo firmetur vas aludel, et circumlinatur ad furnum, quem sequens demonstrat descriptio." (pp. 565 and 566 ; cf. Figs. 1 and 2).

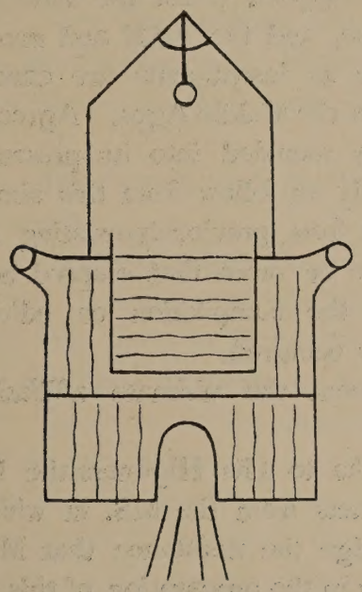

Fig. 1.

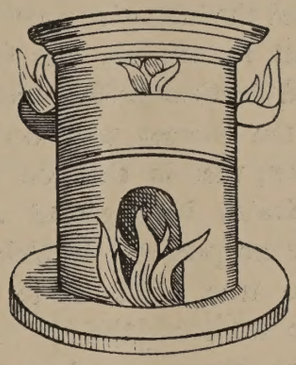

Fig. 2.

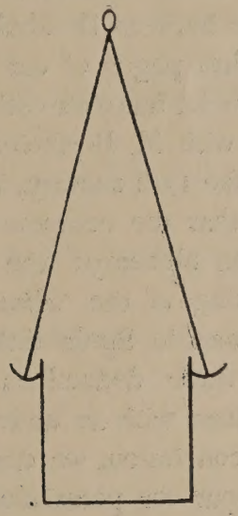

Fig. 3.

" Ex qua materia et qua forma vas Aludel sit faciendum. Cap. XLIIII. . . . Fingatur ergo concha vitrea rotunda, cujus fundus sit parvæ curvitatis, et in medio spondilium ejus formetur zona vitrea circumdans eam, et super illam zonam fundetur paries rotundus æquè distans à conchæ pariete ad grossitudinem cooperculi ipsius conchæ, ita ut in distantia hac cadat paries coopertorii largè sine pressura.

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1 Fac-similes of these figures are to be found in Berthelot's *La Chimie au Moyen Âge*, I, pp. 149 and 150.

2 Probably a mistake for IV, as Fig. 2 shows. Manget, in the reprint of the *Summa* in his *Bibliotheca Chemica Curiosa*, I, p. 532, also reads 'quatuor.'

Altitudo verò hujus parietis sit ad mensuram altitudinis parietis conchæ, aut paulò minus. Formentur verò duo coopertoria ad mensuram hujus concavitatis duorum parietum, æqualia, quorum longitudo sit æqualis, et sit unius spannæ, et figura eorum figura una, scilicet piramidalis, in quorum capitibus duo æqualia sint foramina : unum scilicet in uno, alterum in altero, in quibus ambobus possit cadere major gallinæ penna, ut hîc clarius cernere licebit. Est ergo conchæ vasis intentio, ut possit moveri secundum artificis voluntatem coopertorium illius, et quòd junctura sit ingeniosa, per quam sine lutatione aliqua non pateat spiritibus egressio." (pp. 569 and 570 ; cf. Fig. 3).

M. Berthelot's comment on this apparatus furnishes an excellent epitome of the views that we desire to criticise. He says :—

" Ce sont les formes mêmes des appareils du XIII^e^ siècle. Mais on n'est pas autorisé à les faire remonter plus haut, ni surtout à les attribuer à Geber, comme on l'a fait jusqu'à présent. En effet, les traités arabes authentiques qui portent le nom de Geber ne renferment ni ces figures, ni leur description, ni l'exposé précis des opérations qui s'y accomplissent. Cependant, elles offrent de l'intérêt, même lorsqu'on en limite la date au XIII^e^ siècle." [1]

To these statements the *'Ainu-ṣ-Ṣan'ah* lends no support, whilst the similarity in principle between the aludel and furnace described above, and the *uṯhāl* and *mustauqad* of the last pages of our analysis, proves that so far as instruments are concerned, M. Berthelot has over-estimated the inventive capacity of the Middle Ages. Agreeing, as we do, with M. Berthelot that the *Summa* was finally moulded into its present form during the 13th century, two deductions seem necessarily to follow from this similarity. One is that the contents of the *Summa* were derived from previously-existing Arabic works on alchemy : the other, that in the 200 years or more that elapsed between the writing of the *'Ainu-ṣ-Ṣan'ah* in Baghdād and the compilation or editing of the *Summa* in Spain little or no progress in alchemy occurred.

If these deductions are true, what is to prevent the ultimate affiliation of the *Summa* with an authentic work of Jābir ? [2]

In conclusion, we desire to express our best thanks to His Highness the Nawab of Rampur for permission to study and publish extracts from the MS. in which the *'Ainu-ṣ-Ṣan'ah* was found. We have also to acknowledge the assistance that Maulawī Hidāyat Ḥusain, of the Calcutta Madrasah, has given us in the preparation of this paper.

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[1] *Loc. cit.* p. 149.

[2] It should be added that M. Berthelot's disbelief in Jābir being the author of the *Summa* is mainly based on a consideration of the mystical *Kitābu-r-Raḥmah* (Book of Pity). So far as we can ascertain he has never replied to Leclerc's suggestion that the original of the *Summa* is the *Kitābu-l-Khālis* (Book of the Essence), of which a copy exists in Arabic MS. No. 1083 of the Bibliothèque Nationale (cf. *Histoire de la Mēdecine Arabe*, I, p. 74 ; Ḥājī Khalfa's *Kashfu-ẓh-hẒunūn*, V, p. 79).

II. Analysis of the *'Ainu-ṣ-Ṣan'ah.*

Introduction.

The first three-and-a-half pages of the treatise are devoted to poetical and rhetorical laments on the intellectual poverty of the age, but more especially on the ill-repute into which Alchemy had fallen. This, Muḥammad ibn 'Abdi-l-Malik finally concludes, must be due to the repeated failure of unqualified experimenters. Such men, on discovering the difficulties of the path, are apt to deny the truth of the Art, thus giving the common people—who are always opposed to what they do not understand—an occasion to mock.

The author continues :—

"But if they had followed the right path and learned its inmost truths, they would not have held it to be false, nor have belittled the intelligence of its followers. For this reason I have composed the present work dealing with the subject, at Madīnatu-s-Salām (*i.e.*, Baghdād) in the year 426 (= 1034 A.D.).[1]

It is divided into seven concise chapters.

The First Chapter deals with the Names of Substances, their Classification, and their division into 'Spirits' and 'Bodies.'

The Second treats of their 'Qualities'[2] and the characteristic properties of each of them.

The Third deals with the Proportions and Minimum Amounts of Substances to be used in the Art.

In the Fourth a distinction is drawn between those substances that are suitable for 'the White' and those for 'the Red.'[3]

The Fifth gives an account of the Instruments of the Art and describes the utensils that are necessary for pursuing it.

The Sixth is on the substitution of one substance for another whenever some ingredient is unprocurable.

The Seventh describes two Major Operations for the encouragement of those who desire to benefit by the Art. Concise statements of easy processes in every useful branch of the Art are also given. These I insert in order that the book may form a complete whole.

I have called it *'Ainu-ṣ-Ṣan'ah wa 'Aunu-ṣ-Ṣana'ah* (Essence of the Art and Aid to the Workers), and I have included in it whatever I have personally verified by experiments carried on at the cost of much bodily weariness. I have laboured at it all the days of my life, hoping for the reward of God and the thanks of men, and in order to win the approval of him for whose favors I am thankful [. . . . . Four lines of hyperbole

---

[1] *I.e.*, two years before the death of Ibn Sīnā.

[2] طبائع *ṭabā'i'*, *i.e.* whether they are hot and cold, dry or moist.

[3] *I.e.*, the elixirs by means of which gold and silver can be made.

omitted . . . . .] Ar-Ra'īs Abu-l-Ḥasan 'Alī [ibn] 'Abdillah[1]—May God prolong his precious life and overthrow his enemies!

Be it known that the sages and learned writers such as:

Andria the Sage,[2]
Mūsā ibn 'Imrān al-Kalīm (Moses),[3]
Khālid ibn Yazīd ibn Mu'āwiyah,[4]
Abū Zayd al-Balkhī,[5]
Ma'mar al-Juzjānī,[6]
and the Qāḍhī Abū 'Umar al-Khwārazmī,[7]

who were believers in this science and to whom the interpretations of this Art are due, in addition to many other experts of the first rank, have ceaselessly laboured at the elucidation of obscure points, with the intent that men might derive benefit from their works and profit from their writings—men who, had they been left alone to their own intelligence and common-sense, would not have acquired even the rudiments of this noble science."

After praising at some length these pioneers of Alchemy, Muḥammad ibn 'Abdi-l-Malik proceeds to state that although the materials of this Art are known in every country and sold by every druggist, they are referred to in the Art by enigmatical names.[8] His object, he says, is to explain the Art for the benefit of all men generally, and for the Ra'īs in particular, but at the same time he points out that such knowledge should only be taught to people who are worthy of it.

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1 This patron of Muḥammad ibn 'Abdi-l-Malik was probably one of the nobles at the court of the Buwayhid Prince Jalālu-d-daulah, who was then overlord of 'Irāq and resident at Baghdād.

2 Two alchemical works by an author, or authors, of this name are mentioned in the *Fihrist* (Flügel's ed., p. 354). In one case, the author is said to have been an inhabitant of Ephesus, who dedicated his book to Nicephorus. If this Nicephorus is the first Emperor of that name, the 'Roman Dog' of Hārūnu-r-Rashīd, the date would be *c.* 805 A.D.

3 Moses is mentioned as an alchemist (*a*) by An-Nadīm in the *Fihrist*, p. 351; (*b*) in the alchemical MS. of St. Mark's Venice; cf. Berthelot, *Collections des Anciens Alchimistes Grecs*, I, Introd., pp. 111 and 175.

4 Abu Hāshim Khālid ibn Yazīd ibn Mu'āwiyah ibn Abī Sufyān al-Umawī, "the first (among the Arabs) for whom books on medicine, astrology, and alchemy were translated (from foreign languages into Arabic)," † 704 A.D.; cf. *Fihrist*, p. 354, also p. 224, where he is said to have obtained his translations of alchemical books through the agency of Stephanos the Elder; Ibn Khallikān (De Slane's trans.), I, p. 481, who states the later tradition of his having learnt the Art from a Greek monk named Marianos.

5 The geographer and pupil of Al-Kindī, the famous Arab philosopher. Al-Kindī disbelieved in alchemy (*Fihrist*, p. 261), and though, as has been noticed by De Boer (*History of Philosophy in Islām*, p. 105), As-Sarakhsī, another of his pupils, was probably an alchemist, the statement of Muḥammad ibn 'Abdi-l-Malik seems to be the first indication that Abū Zayd al-Balkhī believed in the Art. He was, however, a contemporary, and (apparently) a friend of Ar-Rāzī, the well-known alchemical doctor (Ibn Abī Uṣaibi'ah, A. Müller's ed., I, p. 319), and it is not impossible that the following books mentioned in Ḥājī Khalfa's *Kashfu-ẓh-Ẓhunūn* (Flügel's trans.) may have contained some references to the subject.

"4193. Jamlu Maṣālihi-l-Anfus wa-l-Abdān, summa rerum animis et corporibus convenientium, auctore Abu Zeid Ahmad Ben Sahl Balkhī, anno 340 (inc. 9 Jun., 951) mortuo" (Vol. II, p. 623). The latter date is an error.

"10328. Kitābu-l-'Ilm wa-t-Ta'līm, liber scientiae et institutionis, auctore Imam Abu Zeid Ahmad Ben Sahl Balkhi, post annum 322 (inc. 22nd Dec. 933) mortuo." (Vol. V, p. 119).

6 Ibn Khaldūn ('Prolegomena,' De Slane's trans., III, p. 71) mentions a Mâmer es-Solemî, who was a denier of predestination. According to De Boer, *op. cit.*, he lived about 900 A.D.

7 It is possible that this is the encyclopædist, Abū 'Abdillah Muḥammad ibn Aḥmad ibn Yūsuf al-Khwārazmī, who devoted the last section of his *Mafātihu-l-'Ulūm* to alchemy (cf. Van Vloten's ed., Leyden, 1895, pp. 255-266).

8 For lists of the enigmatical names of ordinary chemicals that were current in Syria in the 11th cent. A.D., cf. Berthelot, *La Chimie au Moyen Âge*, II, pp. 157-160. The following examples may be quoted: Silver, Leprous Gold; Mercury, the Water of Life; Sal-Ammoniac, the Bird of Khurāsān; Sulphur, the Scorpion.

The first chapter is as follows:—

CHAPTER I.

"The Chapter on the Names of Substances, their Classification, and their division into 'Spirits' and 'Bodies.'[1]"

"Abu-l-Ḥakīm Muḥammad ibn 'Abdi-l-Malik aṣ-Ṣāliḥī al-Khwārazmī saith:

They ask me, 'Whence didst thou acquire Wisdom, when thou art of a people who when spoken to are like cattle?'

I reply, 'I have served men of understanding, and he who serves Princes will himself not lack wealth.'

Although my race and birth place is of Khwārazm I am a man of 'Irāq in my ways and disposition

And my spirit will not be satisfied at the imperfection with which the minds of other men of this age are content.[2]

If any created being could have risen to eminence through natural abilities, I of all men would have reached the highest place.

Know—May God strengthen you!—that among these substances are found the Seven Metals (*Jawāhir*). They are: Gold, Silver, Copper, Iron, 'the two Leads' (*i.e.* Lead and Tin)[3], and Mercury.

A second class are the twelve[4] 'Stones,' *viz*: Sulphur, Arsenic Sulphide, 'Qily,'[5] Lime, Sal-Ammoniac, Salt, 'Zāj,'[6] 'Mārqashīthā,'[7] 'Maghnīsiyā,'[8] [Alum, Borax], and 'Martak.'[9] These are the roots of the Art, [and they are eighteen stones].[10]

---

1 The classification is that adopted by the author of the *Mafātīḥu-l-'Ulūm* (*ed. cit.*, p. 259). 'Spirits' are those substances that volatilise on being heated; 'Bodies,' those that refuse to volatilise. Jābir (*apud* Berthelot, *La Chimie*, III, p. 169) apparently divided substances into 'Bodies' and 'Souls' though, on the other hand, he does not seem to have drawn any strict line of demarcation between souls and spirits. This Muḥammad ibn 'Abdi-l-Malik certainly does, as is evident from the contents of the ensuing chapter, but the contradiction between title and contents seems to show that he was not very sure of his ground.

2 Cf. the couplet of Abū Aḥmad ibn Abū Bakr al-Kātib (*c.* 925 A.D.) quoted by Browne, *Literary History of Persia*, p. 466.

"Wonder not at a man of 'Irāq in whom thou seest an ocean of learning and a treasure of culture;
Wonder rather at one whose home is in the lands of ignorance if he be able to distinguish head from tail."

Also *postea* p. 57, note (3).

3 The Greek belief that tin was a modification of lead was still held, the latter being termed 'black lead,' whilst tin was 'white lead' (cf. Berthelot, *La Chimie*, II, p. 156).

4 Jābir (*Book of Pity, apud* Berthelot, *op. cit.*, III, p. 168) explains this number as being due to the astrological association of the twelve substances with the twelve signs of the Zodiac; cf. also the list given in the contemporary Syriac treatise, Berthelot, *ib.*, II, p. 12.

5 Sodium carbonate. Qily is the ashes of certain plants, *e.g.* Salsola and Salicornia (Ar. حرض *ḥurḍh*, or اشنان *ushnān*), which grow near the sea, or in salty places (Ibnu-l-Baiṭār, *Jāmi'u-l-Mufradāt*, Leclerc's trans., I, p. 88; III, p.).

6 Zāj is the equivalent of 'vitriol,' *i.e.*, the sulphates of Iron, Copper, etc., generally in a more or less impure state; cf. Ibnu-l-Baiṭār, *trans. cit.*, II, p 193., and *postea*, p. 56, note (6). In the *Mafātīḥu-l-'Ulūm* Alum is included among the Zājāt.

7 The Greek (and our) Pyrites, cf. Ibnu-l-Baiṭār, *trans. cit.*, III, p. 312. The *Qānūn* of Ibn Sīnā has the following note on it: "Marqashīthā is of several kinds, Golden, Silvery, Copper-coloured, and Marqashīthā of Iron. Each kind resembles in colour the metal after which it is called."

8 Various black or reddish earths used by the Greeks, and following them, the Arabs, in the manufacture of glass, and for collyria (Ibnu-l-Baiṭār, *trans. cit.*, III, p. 329; *Mafātīḥ.*, p. 261). In classical times in Europe, the 'magnes lapis' was divided into male and female varieties, the former being magnetic iron ore (the 'Maghnāṭīs' of the Arabs). Possibly, therefore, the term 'Maghnīsiyā' may here include Maghnāṭīs, which is mentioned later in Chaps. III and IV as one of the 'Stones'; cf. also *postea* p. 55, note (1); p. 53, text, and note (1).

9 Litharge; otherwise called 'Murdāsanj' (*Mafātīḥ., ed., cit.* p. 263; Ibnu-l-Baiṭār, *trans. cit.*, III, p. 311; and the *Qānūn*).

10 MS. corrupt.

Some include among them Malachite, Lapis Lazuli, 'Shādanj,'[1] 'Tutia'[2] and 'Usrunj,'[3] but exclude Qily, Lime, Salt, Zāj and Alum.

They are also divided into three other classes: 'Spirits,' 'Souls,' and 'Bodies.'[4]

The Spirits are Mercury, Sal-Ammoniac, and similar things.

The Souls are Sulphur, Arsenic Sulphide, and similar things.

The Bodies are Gold, Silver, Iron, Maghnīsiyā, and similar things.

He therefore who desires to prepare any one of the Elixirs must take of the Spirit, one; ofthe Soul, two; and of the Body, one proportion. For example, you take of Mercury, 1 dirham; of whitened Sulphur, or of Arsenic Sulphide, 2 dirhams; and of Iron, one dirham. The Body—which must be completely dissolved—forms, therefore, one-fourth of the whole.

Any elixir which does not contain a Spirit, *viz.*: mercury, and a Soul, which is either sulphur or arsenic sulphide, and a Body, either in a dissolved or coagulated condition, is valueless.

The Spirit and Soul may impart colour, even in the absence of a Body,[5] but the colour they impart disappears on melting. If, however, all three are conjoined, the colour is permanent.

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1 Haematite, other names for it being 'Shādhanah,' and 'Ḥajaru-d-Dam' (bloodstone). Cf. *Mafātīḥ., ed. cit.*, II, p. 262; Ibnu-l-Baiṭār, *trans. cit.*, II, p. 315. *Qānūn*: "Some of it comes from the mine, and some is obtained by the combustion, in a special way, of magnetic iron ore."

2 A substance of doubtful composition, but most probably impure oxide of zinc, cf. Stapleton, *Memoirs, A. .B.*, I, p. 39, note (1). *Qānūn*: "It is produced from the smoke that rises up when copper is being purified from the stony matter, or lead, that is mixed with it." Hunayn († 873), in his translation of Dioscorides, similarly identifies Tutia with Πομφόλυξ, the volatile deposit that collects in copper furnaces.

3 Red Lead. Cf. *Mafātīḥ., ed. cit.*, p. 263: "Lead is burnt, and heated in the fire until it becomes red."

4 The following extract from the *Margarita Pretiosa Novella* of the Italian alchemist Bonus (*c.* 1330 A.D.) affords an excellent summary of the opinions of Arabian alchemists regarding the meaning of the terms 'Body,' 'Soul,' and Spirit.'

"Notandum est, quod antiqui Philosophi hujus artis appellaverunt corpus omne illud, quod secundum sui potentiam naturalem habet fixionem et permanentiam ad pugnam ignis, cum continua perseverantia, et super hoc habet potentiam retinendi secum in commixtione illud, quod non est corpus, et est de sui natura. Incorporeum autem, sive non corpus, sive animam appellaverunt omnem id, quod secundum sui potentiam naturalem, non habet fixionem, nec permanentiam ad pugnam ignis, sed evolatur, et evolat ab igne, et super hoc habet potentiam elevandi in fumum corpus in eo occultum, quod est de sui natura. Et hoc est anima, de qua quidam Philosophorum dixerunt eam esse aerem: quidam ignem: quidam nubem: quidam vaporem incorporalissimum: quidam substantiam tenuissimam: quia secundum analogiam locuti sunt. Spiritum autem appellavererunt omne illud, quod subtiliatum, vel solutum, vel liquefactum ad ignem, secundum sui potentiam naturalem, habet potentiam resolvendi corpus cum anima in vaporem, vel retinendi animam cum corpore ad pugnam ignis, ut non evaporent: quia spiritus cum æqualis fuerit, facit corpus retinere animam: et cum fuerit fortis facit animam separari à corpore, et cum corpore, quoniam sine spiritu nec anima cum corpore manet, nec à corpore separatur cum sit ipsorum vinculum. Una tamen et eadem res in subjecto est habens omnes istas proprietates et operationes. Dum enim in liquefactione permanet ratione subtilitatis dicitur spiritus, sine quo spiritu non potest fieri generatio animæ et corporis, nec conjunctio animæ et corporis. Unde in toto magisterio dominatur spiritus in actu, usque quo generetur anima et corpus. Dum autem volare potest ab igne, dicitur anima: dum autem manere potest in igne, et perseverare, dicitur corpus. Si igitur tempore generationis anima steterit in igne, et prævaluerint vires per vim spiritus, tunc volat ab igne, et trahit secum corpus ad volatum, et permanet operans vacuus à proposito, et expectat quod jam venit, et jam recessit, et nunquam de cætero est venturum, et videtur ei mirabile. Si enim prævaluerint vires corporis, tunc super vires animæ per æqualitatem spiritus, conversum de actu in habitum, tunc corpus retinet animam omnino, nec unquam habet anima vim fugiendi ab igne, et operans tunc habet propositum quod habuerunt tunc antiqui: et tunc spiritus permanet cum eis semper, quandoque in actu, quandoque in habitu: quod totum recipitur ex verbis Platonis in Turba Philosophorum, et in Stellicis ex verbis Senioris, et Haly, et Rasis, et aliorum omnium. Quia igitur hoc corpus perficit et retinet animam, et dat esse sibi et toti operi, et anima in hoc corpore suas vires demonstrat, et per spiritum fit hoc totum, ideo dignè, quamvis metaphoricè dixerunt, corpus formam esse. Unum igitur et idem secundum substantias, quandoque anima, quandoque corpus diversis respectibus" . . . (Manget, *Bibliotheca Chemica Curiosa*, II, p. 41, Note.)

5 *I.e.*, when the Elixir only consists of 'Spirit' and 'Soul.'

The strongest, and most resistant body towards fire is Maghnisiyā. If it becomes clear water,—which is Mercury,[1]—and if there be combined with it a pure Soul, you will accomplish by means of it the great operations. You will thus rise to the height of your ambition, attain your object, and become a Chief of Men.

[. . . 4 lines of doggerel verse omitted. . . .]

The essence of the Art is to separate the Spirit from the Soul; next to kill the Soul; then to return the Spirit to it, so that it may revive and become spiritualised and capable of entering into any body.[2] He who deviates from this path will be able to accomplish nothing."

The chapter ends with a quotation of twelve lines of alchemical verse by an anonymous writer—possibly Khālid ibn Yazīd.

Chapter II.

The Second Chapter deals with the 'Qualities' of substances used in the Art, and what characterises each substance in the various operations to which they are subjected.

Thus Iron is said to be: "Cold, Dry, and of great potency in making 'the White,' 'the Red,' and other tinctures of the metals. It is used in sublimations and in solutions, and from it is prepared the Tincture of the Elixir. It is of two kinds, Male and Female, *Fūlād* (Steel) being the male. The latter is that used for the preparation of Gold; while Soft Iron is the female and is used in the making of Silver. The essence of Iron is red, the crust that forms over it is red,[3] and its filings when killed are red also."[4]

The following is a complete list of the substances mentioned. Quotations have only been added whenever anything of special interest occurs.

Gold . . . . .

Silver . . . . .

Copper . . . . Of two kinds, called respectively '*Sard*' and '*Garm*' (Cold and Hot). The former, which is a grey variety,

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1 In the Greek Dictionary of alchemical terms that is to be found in the contemporary Venice MS. (Berthelot, *Collection*, Trans., I, p. 11) one meaning of Magnesia is said to be Female Stimmi (cf. Pliny, *Hist. Nat.*, XXXIII, 33 and 34). This on reduction would yield antimony or lead, both readily fusible to a liquid resembling mercury, and both capable of easy interaction with sulphur or arsenic sulphide. The passage, in fact, seems to carry us back to the Egyptian theory of lead being the mother-metal (cf. Zosimos, *apud* Berthelot, *trans. cit.*, II, p. 167).

It should be observed, however, that the Arabic of the original is faulty, and hence the translation cannot altogether be relied upon. Cf. also *postea* p. 57, text, and note (1).

2 The passage is only a variation of a well-known alchemical shibboleth; cf. Jābir, *Book of Pity, apud* Berthelot, *La Chimie*, III, p. 169.

3 Lit. 'its skin is red.'

والحديد بارد يابس وقوته شديدة في عمل البياض والحمرة وسائر اصباغ الجواهر وفي الاصعادات وفي المياه ومنه صبغ الاكسير وهو لونان ذكر وانثى فالفولاد الذكر وهو المخصوص بالذهب واللين النرماهن الانثى وهو المخصوص بالفضة . واصله احمر وقشره احمر وبرادته اذا ماتت كانت حمراء *

	comes from Mosul and the towns of Syria.[1] The latter is red, and is brought from Baṣrah and the towns of Khurāsān.
Iron	(See above.)
Tin (*Qal'ī*)[2] . .	
Mercury	On account of its excessive heat, it has the property of killing lice.[3]
Sulphur	Both Body and Spirit.[4] It unites with heated bodies, and completely destroys them. It also blackens Silver and Copper. Of its different varieties—yellow, white, and red,—the red is only found in the West and is much used in the making of Gold. The White has a strong smell.
Arsenic Sulphide .	Red, Yellow, Bay-coloured (دیزج *Daizaj*) and Grey. The '*Daizaj*' is the variety that is used, mixed with lime, as a depilatory. The other varieties after calcination, whiten copper and remove its offensive odour.[5]
Qily	
Lime	
Sal-Ammoniac . .	
Salt	
[Borax	Only mentioned incidentally as a cleansing agent, comparable to salt.]
Zāj	The names of its varieties are: 'Qalqaṭār,' 'Sūrī,' 'Qalqadis,' and 'Qalqand.'[6]
'Iqlīmia' of Gold, or "Mārqashīthā."	It contains an admixture of Sulphur. . . . After this sulphurous part has been burnt away, . . . it enters into many processes of the Art.[7]

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[1] Evidently a light-coloured alloy. It is probably that referred to in Bar Bahlūl's Syriac Dictionary (written at Baghdād *c.* 950 A.D.) as 'Bīlati,' or White Copper. (Duval's trans., *apud* Berthelot, *La Chimie*, II, p. 123).

[2] It is a remarkable fact that metallic Lead is never alluded to in the experimental chapters of the *'Ainu-ṣ-Ṣan'ah*, although some of its compounds are mentioned.

[3] A similar statement is quoted from Ar-Rāzī by Ibnu-l-Baiṭār (*trans. cit.*, II, p. 229).

[4] Cf. the statement of the contemporary Syriac treatise, published by Berthelot (*La Chimie*, II, p. 73) that Arsenic Sulphide possesses both a soul and a body.

[5] *Daizaj* may also mean 'ash-coloured.' This translation would bring the description into harmony with the present-day Indian custom of using a more or less completely oxidised *Zarnīkh* (arsenic sulphide) as a depilatory. The whitening of the copper would be due to the formation of copper arsenate. For a similar statement, cf. Ibnu-l-Baiṭār's quotation from the pseudo-Aristotle's *Book of Stones*, *trans. cit.*, II, p. 205.

[6] The Greek Χαλκητάριν, Σῶρι, Χαλκῖτις and Χάλκανθον; cf. Bar Bahlūl, *loc. cit.*, p. 124, and this paper, *antea*, p. 53, note (6). For their preparation, see the contemporary Syrio-Arabic treatise, *apud* Berthelot, *La Chimie*, II, pp. 146 and 147.

[7] 'Iqlīmia' (from which our word 'calamine' is derived) is identified by Bar Bahlūl, *loc. cit.*, p. 127, with 'cadmia,' one of the volatile products formed in the manufacture of silver and copper (Dioscorides, *Materia Medica*, V, 84). In the *Mafātīḥu-l-'Ulūm*, *ed. cit.*, p. 263, the word is spelt *Qalīmia* and is defined as the impurity that separates from anything. The alteration of

Maghnīsiyā . . .	Male and Female, the latter variety being black, soft, and of a yielding texture. It is a great colouring agent.[1]
Alum	A desiccating and cleansing agent. The 'alum of redness,' which is commonly called the 'alum of Yemen,' is clear and white. The 'alum of blackness' is grey.
Martak	Very soluble in vinegar.[2]
'Maghnāṭīs' . .	Attracts iron on account of its excessive heat.

Chapter III.

"On the Proportions and Minimum Amounts of Substances that are used in the Art."

"Muḥammad ibn 'Abdil-Malik al-Kāthī[3] saith:

The minimum quantities of these substances that are required for experiments in the processes that I shall describe for the two Major Operations are as follows[4]:—

Pure Gold ...	...	$3\frac{1}{2}$ mithqāls	=	5 dirhams
Pure Silver ...	...	...	=	4 ,,
Red Copper of Khurāsān	...	5 ounces	=	$53\frac{1}{3}$,,
Copper of Mosul ...	...	...	=	1 ,,
'Rūsakhtaj'[5] [of Baṣrah	...	1 ounce]	=	$10\frac{2}{3}$,,
'Zinjār'[6] of Ḥimṣ (Emessa)	...	3 ounces	=	32 ,,

Cadmia into Qalīmia was probably due to a copyist having mistaken the د (dāl) of the transliterated word for a ل (lām). The fact that Pyrites contain sulphur is also mentioned in the alchemical treatise of the 'Brethren of Purity' (*c.* 970 A.D.).

[1] Cf. the following extract from the alchemical treatise of the 'Brethren of Purity.' "Maghnīsiyā is a noble stone, which the Sages held in high esteem and ancient philosophers have praised. By it they were accustomed to perform many works, and dissolve by means of it every kind of 'nature' (*ṭabī'ah*) in mineral bodies. It softens iron and glass. One kind of it is male, and another—which they call *dhālībis*—female. The male is dry, while the female is soft and black. They marry it with the sulphur called ἄπυρον (unburnt), and the mixture is then projected on to tin, which is thus converted into silver" (MS. in the Library of the Asiatic Society of Bengal).

[2] *I.e.*, to form 'sugar of lead.'

[3] Kāth was a large town of Khwārazm, situated on the East bank of the Oxus, 20 *farsakh* (60 miles) from Kūrkānj (Khiva), the capital of Khwārazm: cf. Yāqūt, Wustenfeld's ed., IV, p. 222. The geographer Muqaddasī (985 A.D.) declares that it was one of the filthiest towns he had ever seen, and his description of the intellectual attainments of its inhabitants is the reverse of flattering.

[4] The table of weights used is as follows:—

2	qīrāṭs	=	1 dānaq
6	dānaqs	=	1 dirhams
7	mithqāls	=	10 dirhams
$10\frac{2}{3}$	dirhams	=	1 ounce (*ūqiyyah*)
12	ounces	=	1 raṭl

[5] According to the *Makhzanu-l-Adwiyah* of Mīr Muḥammad Ḥusain, this is a corruption of روی سوختہ *Ruy-i-Sūkhta*, 'Burnt Brass,' *i.e.*, Copper Oxide. See also Ibnu-l-Baiṭār, *trans. cit.*, III, p. 366. Another form of the name is راسخت *Rāsakht*. The *Saktah* mentioned on p. 262 of the *Mafātīḥu-l-'Ulūm* seems to be the same substance.

[6] Verdigris, made by the following process: "Plates of copper are put into the dregs of vinegar and are thus turned green. Then they are scraped, and the process repeated until all the copper has been converted into Zinjār." (*Mafātīḥ., ed. cit.*, p. 263). The method is identical with that described by Dioscorides, V, 91, and is probably copied from Ḥunayn's translation of the *Materia Medica*.

Soft Iron, *i.e.*, the female ...	7 ounces	=	$74\frac{2}{3}$	dirhams.
Steel, *i.e.*, male iron ...	2 ,,	=	$21\frac{1}{3}$	,,
Tin (*Raṣāṣ Qal'ī*) ...	...		10	,,
Mercury[1]	11 ounces	=	$117\frac{1}{3}$	,,
Yellow Sulphur of 'Irāq[2] ...	19 ounces and 7 dirhams	=	$209\frac{2}{3}$	,,
Yellow Arsenic Sulphide [----]	$2\frac{1}{3}$ raṭls	=	$298\frac{2}{3}$	,,
Qily	10 raṭls—out of which $4\frac{1}{2}$ ounces of salt are made[3]	=	1280	,,
Lime	3 ounces	=	32	,,
Sal-Ammoniac of Khurāsān[4] ...	2 ounces and 6 dirhams (?)	=	$27\frac{1}{3}$	,,
Sweet Salt	2 raṭls	=	256	,,
Egyptian Zāj[5]	5 ounces	=	$53\frac{1}{3}$	,,
Qalqand	3 ,,	=	32	,,
Iqlīmia of Gold or 'Mārqathīthā'	10 ,,	=	$106\frac{2}{3}$	,,
Female Maghnīsiyā—black, soft, and of a yielding texture	...		6	,,
Alum of Yemen	$7\frac{1}{2}$ ounces	=	$80\frac{1}{3}$	,,
'Tinkār'[6]	$\frac{1}{2}$ ounce	=	$5\frac{1}{3}$	,,
Martak	1 ,,	=	$10\frac{2}{3}$	,,
Maghnāṭīs	16 qīrāṭs	=	$1\frac{1}{3}$	,,
Red Armenian Borax[6] ...	2 ounces	=	$21\frac{1}{3}$	,,
'Naṭrūn'[6]	...	=	$8\frac{1}{3}$	,,
Hens' Eggs	50		...	

The total is $2758\frac{1}{3}$ dirhams.

If you need larger quantities of the medicines than those given, multiply the weights

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1 Yāqūt, who completed his geographical Dictionary *Mu'jamu-l-Buldān* in 1224 A.D. states that the best mercury of his time ('better than that of Khurāsān') was drawn from Shīz, a town in the mountainous district S.W. of the Caspian, and S.E. of Lake Urmiyah. Gold, Lead, Silver and Orpiment were also obtained from the same place. Shīz was the reputed birthplace of Zoroaster, and its famous fire-temple was said to have been erected on the spot where the Magus, sent by Khusrū Hurmuz (*sic*) to the Virgin Mary, fell ill and died on his return journey from Bethlehem. The sacred fire of this temple burnt without producing any ashes, and from it the flames of all the other fire-temples in Persia were re-kindled when they became extinct (*ed. cit.*, III, p. 353.).

2 Bar Bahlūl (*loc. cit.*, p. 132) states that this yellow sulphur was procured from Mt. Bārimmā, on the Tigris between Mosul and Takrīt.

3 From the small amount of salt that is produced from 10 raṭls of Qily, it would almost appear that 'Qily' here means the dried soda plant, and not the ashes left after its combustion.

4 This is the naturally occurring volcanic product and is probably, therefore, ammonium chloride; cf. Ibnu-l-Baiṭār, *trans. cit.*, III, p. 380; Stapleton, *Memoirs A.S.B.*, I., p. 29, text, and note (5).

5 Mentioned in the *Qānūn* as a green variety, stronger in its medicinal action than Cyprian Zāj.

6 Tinkār, Red Armenian Borax, and Naṭrūn were different varieties of the بورق 'Būraq' (borax) of the Arabs (*Mafātīḥ.*, *ed. cit*, p. 260; Ibnu-l-Baiṭār, *trans. cit.*, I, pp. 289 and 289). This term certainly included other fusible substances besides our Borax since Naṭrūn is sodium sesquicarbonate. The *Qānūn* states that the Armenian was the best variety. It occurred naturally in soft, spongy flakes, of a white, reddish, or purplish colour.

equally, without increasing one, or diminishing another ; lest the work should be spoilt, and your object be not attained. If you increase the weight of one substance you should add to the others proportionately. By observing this rule, you will—if it please God !—attain your object and reach the extreme limit of your desires."

Chapter IV.

In this chapter, the substances mentioned in the previous chapter are divided into two classes according as they are suitable for making 'the White,' or 'the Red.' Weights of the substances—here referred to collectively as 'Stones' (*Aḥjār*)[1]—are stated as before in raṭls, ounces, dirhams, and qīrāṭs, but for purposes of tabulation, only the number of dirhams of each need be quoted.[2]

Substances employed.	(*a*) For 'the White.'	(*b*) For 'the Red.'
Pure Gold	...	5[3]
Filings of Silver	4[3]	...
Red Copper of Khurāsān	...	$53\frac{1}{3}$
Filings of Copper of Mosul ...	1	...
Rūsakhtaj of Baṣrah	$10\frac{2}{3}$	...
Zinjār of Ḥimṣ	...	32
Filings of Female Iron	$74\frac{2}{3}$	...
Filings of Steel—*i.e.*, Male Iron ...	...	$21\frac{1}{3}$
Tin (*Raṣāṣ Qal'ī*)	10	...
Mercury	$90\frac{2}{3}$	$26\frac{2}{3}$
Yellow Sulphur	7	$202\frac{2}{3}$[4]
Yellow Arsenic Sulphide [----] in flakes	256	$42\frac{2}{3}$
Salt of Qily	...	"48 dirhams.[5] This is made out of 1280 dirhams of Qily."
Lime—unslaked	...	32
Sal-Ammoniac of Khurāsān ...	22	$5\frac{1}{3}$
Salt of Dough	256	...
Egyptian Zāj	...	$53\frac{1}{3}$
'Qalqant'	...	32
'Iqlīmia,' or 'Yellow Mārqathīthā' ...	...	$106\frac{2}{3}$
Female Maghnīsiyā—black, soft, and of a yielding texture	6	...

[1] The word is employed in the same sense that it possesses in the *Mafātīḥu-l-'Ulūm*—"anything by which the Art can be performed, that is, anything out of which Elixir can be made" (*ed. cit.*, p. 265)—and not in the more limited meaning of Chap. I.

[2] A similar statement is found in the contemporary Syrio-Arabic treatise of the British Museum (Berthelot, *La Chimie*, II, pp. 164 and 165), but the lists there given are too confused for any useful comparison to be made with them.

[3] The fact that this table calls for the use of a small quantity of gold in producing gold, and a similar quantity of silver in making silver, is probably to be explained on the principle of 'like producing like.'

[4] Corrected. MS. تسع عشرة اوقية وهي مائة وستة وتسعون درهماً '19 oz = 196 dirhams.'

[5] Corrected. MS. اربع اواق ونصف وهي ثما نية واربعون درهماً واربعة دوانق '4½ oz = 48¾ dirhams.'

COMPARATIVE TABLE.—*Contd.*

Substances employed.	(*a*) For 'the White.'	(*b*) For 'the Red.'
Alum of Yemen	$80\frac{1}{3}$	...
Tinkār	...	$5\frac{1}{3}$
Martak	...	$10\frac{2}{3}$
The stone Maghnātis	...	$1\frac{1}{3}$
Armenian Borax	$21\frac{1}{3}$	...
Naṭrūn	...	$8\frac{1}{3}$
Hens' Eggs	...	50[1]
TOTAL	$839\frac{2}{3}$	$1918\frac{2}{3}$[2]

CHAPTER V.

The fifth chapter, if complete, would probably have been found to contain a full description of the instruments used in Alchemy. The MS., however, is corrupt, and after giving a list of the instruments necessary for making 'the White,' it breaks off at the beginning of the corresponding list of instruments for 'the Red' into an account of two alchemical processes, called respectively the 'Second Pillar' and the 'Third Pillar.' It is impossible to say whether these sections belong to Chapter V, or, as is perhaps more likely, to Chapter VII, since the MS. ends before even the 'Third Pillar' has been fully described.

We quote the list of the instruments, so far as it goes, as well as an incomplete account of a home-made '*Uṯhāl*' (Aludel) that occurs in the 'Third Pillar.'

"An Account of the Instruments, giving details of those that should be either purchased or made for the manufacture of 'the White.'"

"Muḥammad ibn Abdi-l-Malik al-Kāṯhī saith: Among them are:—

(1) A File (*Mibraa*) for filing silver, copper, and iron.

(2) Two glass Cups (*Qadaḥ*) without spouts, for the volatilisation[3] of silver.

(3) A stone '*Ṣalāyah*' and a '*Fihr*'[4] for pounding medicines.

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1 The Syrio-Arabic treatise also mentions the employment of yolks of eggs in its chapter on the manufacture of gold (*loc. cit.*, p. 179).

2 Corrected. MS., الف وتسعمائة وثلثلة وخمسون درهماً واربعة دوانق, $1953\frac{3}{4}$ dirhams. The corrected total includes the weight of Qily, but not its salt. The eggs are also excluded.

3 As the word *Taṣʿīd* is generally used for solids and not liquids (*Mafātīḥ.*, p. 264) the sublimation of some compound of silver from a mixture of silver filings and various salts, is probably here meant, and not the actual distillation of silver itself.

4 Cf. the list of instruments given in the Syrio-Arabic treatise (*loc. cit.*, p. 150). The *Ṣalāyah* and *Fihr* are the modern *Sil* (سل) and *Lorha* (لوڑھا), the oblong flat stone, and roller, used in India for making curry powder. The dimensions of the alchemical *ṣalāyah* are stated in the same treatise (*loc. cit.*, p. 167) to be 1 cubit long by 3 cubits broad, *i.e.* about three times the size of the common form. The Syrio-Arabic author also states that the *Fihr* should be made of jet-black stone.

(4) Five large earthenware Jars (*Barānī*), glazed inside, and provided with lids, for heating purposes.

(5) Three earthenware Pots (*Qudūr*) glazed inside, for the long *Uṯhāl* that is used in volatilising[1] Tin and other things, together with three Covers (*Mikabbāt*) of unglazed earthenware for covering the *Uṯhāl*.

(6) (*a*) A piece of coarsely-woven Hair Cloth,[2] used in the process of *Ḥall*[3] for Tin and other things. This process occupies 40 days.

(*b*) A glass Funnel (*Qim'*)[4], over which the hair-cloth is stretched, for the reception of whatever has to be dissolved.

(*c*) A large glass Bottle (*Qinnīnah*), in the mouth of which the funnel is placed, so that the dissolved substance drops into the bottle.

(*d*) A felt covered Basket (*Sallah*) or Cage (*Qafaṣ*) inverted over the bottle to preserve the medicine from injury when in the dung.

(7) A stone Mortar (*Hāwan*) for pounding sulphur and similar substances.

(8) A large Cup for washing mercury.

(9) (*a*) A large Crucible (*Būṭaqah*).

(*b*) A Furnace|(*Kūr*).

(*c*) Bellows (*Minfāḵh*).

(*d*) A pair of Pincers (*Kalbatān*).

(*e*) A '*Māshak*' (Ladle).[5]

All these are for use in the fusing together of Mercury and Arsenic Sulphide.

(10) A Cauldron (*Mirjal*), or Pot (*Ṭinjīr*), in which to dissolve alum.

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[1] See *antea*, p. 60, note (3).

[2] Lit. "a piece of hair sieve."

[3] A convenient translation of the important word *Ḥall* (lit. 'loosening') is 'Dissolution.' It is defined in the *Mafātīḥu-l-'Ulūm* (*ed. cit.*, p. 264) as the reducing of solid substances to the state of water, and a good idea of one method of performing it may be obtained from the following translation of the article on *Ḥall* that is given in the Syrio-Arabic treatise (*loc. cit.*, Text, p. 81).

"DISSOLUTION.—Take the substance after it has undergone the process of 'Ceration' (cf. Stapleton, *Memoirs A.S.B.*, I, p. 39, text, and note (2), and having pounded it finely, place it in a hair sieve that is not fitted with a hoop. You must then join the sides of the sieve and tie them together with a very strong string made of hair. Next, you take a pot, and having pierced a hole in the bottom large enough for the string to enter, you hang the thread from it. The pot should be inverted on its face and under it is placed a cup of '*ghaḍhār*,' large and wide. The sieve should be suspended by the string in the middle of the pot, and the pot placed over the cup in such a way as to cover it.

"Then without disturbing the apparatus, you bury it in a large quantity of moist dung. Change the dung every 10 days. The substance will gradually dissolve and fall from the sieve in drops of red water. Take it and put it on one side. Dissolution requires 42 days or more. If you heat a dirham, and let fall on to it a single drop of this water, it will colour both its exterior and interior." For a hypothetical reconstruction of this apparatus, see Plate I, Fig. 4.

In the process described in the text, and figured hypothetically in Plate I, Fig. 5, the bottle—after the funnel containing the hair cloth and substance has been placed in position—is covered with a felt-covered basket (*Qafaṣ*), which is then packed round with dung. In the course of 40 days the substance deliquesces by the absorption of the vapours given off from the dung and the resultant liquid collects in the bottle.

[4] The well-known dictionary *Lisānu-l-'Arab* (written in the 13th cent. but based upon works of the 10th cent.) has the following note on the *Qim'*. "It is that which is placed in the mouth of water, wine, and milk skins when they are being filled. Its name is derived from قمع *qam'*, to enter, because it enters into the mouth of the vessel." (Būlāq ed.).

[5] *Māshak* is taken to be the Arabicised form of the Persian ماشو *māshū*, a ladle. If this is correct, the list of instruments for fusing that is given in the *'Ainu-ṣ-Ṣan'ah* becomes identical with that given on p. 256 of the *Mafātīḥu-l-'Ulūm*.

(11) Phials (*Qawārīr*) for the process of '*Takhnīq*,'[1] similar to those used for holding rose-water.

(12) A large Bottle for the dissolution of all the medicine, a process which occupies 33 days. The entire period of dissolution for the making of silver is therefore 73 days, besides the days on which the medicines are being prepared for dissolution. And God is the Giver of Success!

"An Account of the Instruments, either purchased or chosen (?), for the preparation of 'the Red.'"

"Muḥammad ibn 'Abdi-l-Malik saith: Among them are:—

(1) A *Ṣalāyah* and a *Fihr* for pounding Zinjār and other selected medicines.

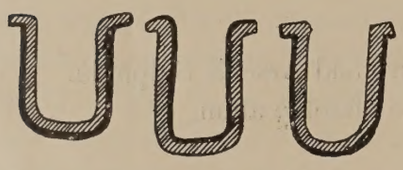
(2) Two large earthenware Jars glazed inside, and provided with lids, for heating purposes."

* * * * * *

Description of the 'Uthāl' (Aludel), with its Furnace.

[The treatment of a mixture of various substances is being described.]

"Having pounded it (*i.e.*, the mixture), you take the three pots of the *Uthāl* which are of this shape, the length of each being a cubit,[2] the aperture one span, and the lips projecting about four finger-breadths. They are constructed by potters of '*ghaḍhār*,'[3] and are glazed on the inside.



Black
Red.

Fig. 6.

In addition, take three round-bottomed covers, also made of baked *ghaḍhār*, but unglazed. Their sides are pierced with a hole at 'four fingers' distance from the top, measuring towards the rim, the size of the hole being such that a stick of the thickness of a bodkin can enter, to extract the moisture and by means of which the progress of the sublimation may be studied. The diameter of the covers is exactly the same as that of the lips of the *uthāl*.

If these vessels cannot be procured, you take (*a*) a cup made of *ghaḍhār*, or a '*Sāghar*,'[4] and (*b*) a large green jar or a '*Bustūqah*,'[5] of the capacity of two 'dauraqs' of water, the weight of each dauraq being 1040 dirhams. You cut it (*i.e.*, whichever one of the latter you choose) into two halves with a saw and take the lower half for conversion into an *uthāl*.

The method of doing this is as follows. You prepare a large disc (*turs*) of the 'Clay of

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1 According to another treatise in the Rampur MS., the process of *Takhnīq* (lit. 'strangling') is a kind of sublimation. The substance under treatment is placed in a short-necked phial and heated gently until it has volatilised into the neck.

2 Lit. 'the arm bone.'

3 A special kind of greenish clay.

4 A large drinking cup (Persian).

5 An elongated jar for storing butter and other supplies (Persian). Taking a 'aṭl' as equal to 1 lb. of water, the capacity of the *bustūqah* here mentioned would be a little more than 1½ gallons.

Wisdom,'[1] of the breadth of two spans and the thickness of a thumb, and while it is still moist, you invert on its centre the lower half of the jar. By exerting a little pressure, you obtain the measure of the circumference and its mark is impressed. After removing the jar, you take the cup of *ghaḍhār*, and invert it on the disc, pressing it down so that it may also leave its mark.[2] This in turn is removed, and the layer left in the shade to dry. When it is well dried, you take it and having cut out the centre with a knife up to the limit of the mark of the jar, you mount it (*i.e.*, the ring of clay that remains) on the top (?) of the lower half of the jar, just like the lips of the pots made of *ghaḍhār*. The joint is luted with clay, and when this is dry, the instrument resembles in shape the ordinary *uṯhāl*. It is then taken and half covered with 'clay of wisdom' to the thickness of a thumb. You also affix, half-way up, four handles of clay so that it may rest on the '*Mustauqad*' (furnace). Finally the clay is allowed to dry.[3]

You next build for this *uṯhāl*, a round *mustauqad*, similar in appearance to the *mustauqad* of the sweetmeat sellers, having a small door for the fuel and two openings on the right and left, at the height of a '*shakankah*'[4] from the ground for the smoke to go out of. The height of the top of the *mustauqad* from the ground is two spans and the breadth of the aperture three spans.

The *uṯhāl* is mounted on the *mustauqad* according to the annexed figure. Between its sides and those of the *mustauqad* there is a space of four fingers[5] for the tongue of the flame to play in, and between the bottom of the pot and the ground a distance of a span. You must also make certain of the junction between *uṯhāl* and *mustauqad* by covering in with clay all round.[6]

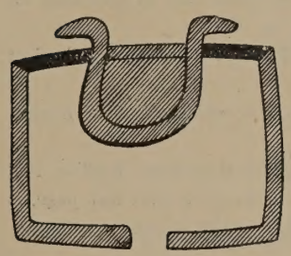

Fig. 7.

When the *uṯhāl* is properly fixed in position, you take a little '*Isfīdāju-l-Juṣṣ*' (shell lime) and having pounded it up with water, you smear it on the surface of the lip and leave

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1 Earlier in the 'Third Pillar' of the '*Aínu-ṣ-Ṣan'ah*, it is mentioned that the special luting clay ('Clay of Wisdom,') employed by Muḥammad ibn 'Abdi-l-Malik, consisted of two-thirds *Ṭīnu-l-Ḥurr* (clay, free from stones; see Ibnu-l-Baiṭār, *trans. cit.*, II, p. 424) and one-third of a mixture of dried dung and chopped animals' hair. From Bar Bahlūl, *loc. cit.*, p. 137, it would seem probable that the stone-free clay used in making 'clay of wisdom' came from Assuan in Upper Egypt.

2 As is evident from what follows, the rim of the cup is of larger diameter than that of the jar.

3 With this compare the following extract from the contemporary Syrio-Arabic alchemical MS. published by Duval in Vol. II. of Berthelot's *La Chimie au Moyen Âge*, p. 69.

"Take a pot shaped like a '*Burmah*,' of the length of one cubit, and breadth two hands, and invert it on a level surface. After throwing sifted ashes round it for the space of a hand and a half, you remove the pot, and cover the ashes with clay up to the same limit. When the ring of clay is dry, lift it up and polish its surface with '*Isfīdāj*' and white of egg. Polish it a second time.

[Here comes an unintelligible sentence. The copyist also seems to have omitted a sentence describing the fixing of the ring on the top of the pot.]

"Then invert the pot of the *uṯhāl* on its face and after covering it evenly with clay all round, encircle the pot with wings, one hand below the shelf (*turs*, lit. 'disc'), in order that the flame of the fire may not affect whatever settles on the shelf, and so burn and damage it. Finally invert the cover on the *uṯhāl*. There is a mystery in this which we shall mention when giving an account of sublimates."

4 This measure of length does not seem to be mentioned in any Persian or Arabic dictionary

5 The home-made *uṯhāl* is apparently broader than the ready-made *uṯhāl* mentioned at the beginning of this section, as in the case of the latter, the distance between the sides of the *uṯhāl* and *mustauqad* would be one span. Little reliance can be placed on the drawing, for according to the description, only half the length of the *uṯhāl* should be within the *mustauqad*.

6 Cf. the Syrio-Arabic MS., *loc. cit.*, Text, p. 79:

it. Over this you sprinkle a little salt water, and then gently polish the surface with a polisher made of glass, in such a way that nothing is broken. After these preliminaries, two raṭls of the medicines that you wish to sublime—and no more—are placed inside, for if you introduce a large amount, it will refuse to volatilise. You next take the cup of *ghaḍhār*, and having pierced a hole in its side, large enough for a stick of the size of a bodkin to enter, at three fingers' distance from its rim, measuring towards the top, you invert the cup on the mark that is on the lip of the *uṯhāl*, according to the annexed figure. Then you take a little of the moistened *isfīdāj*, and pour it into the joint" . . . .

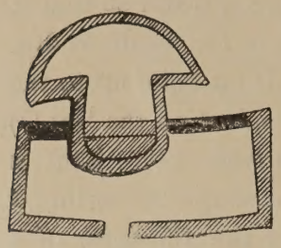

Fig. 8.

[At this point the MS. comes to an end.]

"Sublimation by means of the *Mustauqad*. Sublimation is carried on in a pot of earthenware, a pot of glass, or a pot of *ghaḍhār*.

These are the points to be observed :—

(*a*) The pot should be luted with 'clay of wisdom' besides being encircled with a collar of clay of the width of two fingers, so that it may stand firm on the *mustauqad*.

(*b*) The *mustauqad* should be round, with a door one span long by one span broad, and two apertures, one on each side, for smoke, and for air to enter.

(*c*) Between the bottom of the pot and the *Mustauqad* there should be a span's breadth, the collar of the pot being affixed at one-third of the distance from the top.

(*d*) If the pot is of glass, it should have a wide projecting lip of the breadth of four fingers. Its cover, which will close it completely (?), should also be of glass."

As there is little doubt that the Syrio-Arabic MS. is a volume of selections and not a single homogeneous treatise, the marked differences between the references to the *uṯhāl* contained in this extract and those given in the note on the previous page, is very probably due to their being drawn from different sources.

III. Arabic Text.

كتاب عين الصَّنْعة وعون الصَّنَعة الفه الشيخ الاديب محمد بن عبد الملك الصالحي الخوارزمي الكاثي[a] رحمة الله عليه *

بسم الله الرحمن الرحيم عونك يا لطيف

ان اولى ما بدئ به النطق وافضل ما زُيّن به الرق واحرى ما استقصيت به الطلبة واحق ما تلقيت به الموهبة حمدُ الله على نعمه السالفة والشكر له على مننه الآنفة والثناء على ما هو اهله ومستدعيه و مستأهله والصلوة على صفوته من انبيائه وخيرته من اصفيائه محمد صلى الله عليه وآله وسلم تسليما دائما كثيرا قال الشيخ الامام الاديب محمد بن عبد الملك الكاثي الخ *

[3 *pages (of* 19 *lines to the page) and* 7 *lines omitted.*]

ولو انهم سلكوا مسالكه وملكوا ممالكه وعرفوا حقائقه لما عابوه ولما استنقصوا عقول اربابه وذويه فصنفت كتابي بمدينة السلام في سنة ست وعشرين واربعمائة وجعلته سبعة ابواب بلا تطويل ولا اسهاب فاول الابواب في اسماء العقاقير واعدادها والتنبيه على ارواحها واجسادها وثانيها في طبائعها وما يختص به كل واحد منها وثالثها في تحـــزيزها[b] وتقديرها وتجزئتها وتدبيرها ورابعها في افراد ما يصلح منها للبيـــاض مما يصلح منها للحمرة وخامسها في ذكر آلاتها وشرح ما يحتاج اليه من ادواتها وسادسها في استبدال بعضها من بعض لقلة وجودها في ارض دون ارض وسابعها في تركيب بابين ليرغب متاملّوا الفائدة في تقنيتها مع نتف من الاعمال الهينة في كل من الفنون المستحسنة اضفها آخره ليكون كاملا في صفته وسميته عين الصنعة وعون الصنعة واودعته ما صح عندي مما جربته يدي وشقي في مقاساته بدني واشتغلت ايام زمني محتسبا للثواب الجزيل وملتمسا للثناء الجميل وانتهازا لوفاق من انا لاحسانه شاكر ولمحاسنه في المحافل ناشر حتى كأنّ كل عضو من اعضائي لسان بشكره ناطق وكل نفس من انفاسي ببيان ثنائه صادق

a) MS. الكاني b) MS. تحزيرها

* شعر *

افادي بالثنـــاء بكـــل ناد واعلنـــه كاعـــلان الاذان
وانظم من محاسنه عقـــودا فاجعلهـــا قـــلائد للـــزمان

هو الرئيس ابو الحسن علي [بن] عبـــد الله اطال الله عزيز بقائه وكبت شانئيه a ولاجرم ان الحكمـــاء المصنفين والعلماء المؤلفين كاندريا الحكيم وموسى بن عمران الكليم وخالد بن يزيد بن معاوية وابي زيد البلخي ومعمر الجرجاني والقاضي ابي عمر b الخوارزمي اصحاب هذه المقالة وما تضمنته من الشروح والاطالة وغيرهم من المتقدمين من جميع الصناميين c [؟] اتعبوا مطايا العقول في اخراج الملتبس في المعقول لينتفع بتصانيفهم ويرتفق بتآليفهم من لو خلي وسوم عقله ووكل الى تمييزه وتحصيله لما وقف على وتح طفيف من هذا العلم الشريف *

[29 *lines omitted.*]

باب اسماء العقـــاقير واعدادها والتنبيـــه على ارواحها واجسادها * قال ابو الحكيـــم محمـــد بن عبد الملك الصالحي الخوارزمي * * شعر *

يقولون لي انّى استتبّت [لك] d الحكم وانت فمـــن قوم اذا استنطقـــوا نعم
وقولي لهم ني خدمت اولي النهى ومن خدم السادات لم يعـــدم النعـــم
فان كان في خوارزم قومي ومولدي e فاني عراقـــي الطـــرائق والشيـــم
ولي همة لا ترتضي النقص في الذي به ترتضـــي في عصرنا سائر الهمـــم
ولو نال خلـــق بالفضـــائل رتبة لنلت f اعاليهـــا بهـــا دون ذي الامم

فاعلموا اعزكم الله ان من اسماء هذه العقاقير الجواهر السبعة وهي الذهب والفضة والنحاس والحديد والرصاصين والزئبق ومنها الاحجار الاثنا g عشر الكبريت والزرنيخ والقلي والنورة والنوشادر والملح والزاج والمـــرقشيثا والمغنيسيا [والشب والبورق h] والمرتك وهذه اصول i الصنعة وهي ثمنية عشر حجرا ومن النـــاس من يجعل فيها الدهنج واللازورد والشادنج والتوتيا والاسرنج j والمستط منها القلي والنورة والملح والزاج

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a) MS. وكتب مثاربه b) MS. inserts و between عمر and الخوارزمي c) MS. الصغويين
d) The addition is necessary for purpose of scansion. e) MS. ومولودي f) M.S. لثلث g) M.S. الاثنى
h) The copyist has omitted two out of the total of twelve, but judging from the list given in Chapter III. these appear to be the missing substances. i) MS. الاصول j) MS. والاسوب

والشب وهي ثلثة اجناس ارواح وانفس واجساد فالارواح الزئبق والنوشادر وما شاكلهما [a] والانفس الكبريت والزرنيخ وما اشبههما [b] والاجساد الذهب والفضة والحديد والمغنيسيا وما جانسها فمن اراد ان يخلط اكسيرا من الاكاسير فينبغي ان يجعل من الروح واحدا ومن النفس اثنين ومن الجسد واحدا مثال ذلك ان تاخذ من الزئبق درهما ومن الكبريت المبيض او الزرنيخ درهمين ومن الحديد درهما فيحصل الجسد ربع الاجزاء كلها بعد ان يحل الجسد حلا شافيا وكل اكسير لا يكون فيه الروح التي هي الزئبق والنفس التي هي الكبريت او الزرنيخ ثم جسد محلول او مجمد فليس بشيء وقد يصبغ الروح والنفس بلا جسد الا ان صبغهما ينسلخ في السبك واذا اجتمعت الثلثة لم ينسلخ الصبغ واقوى الاجساد واصبرها على النار المغنيسيا اذا صار ماء رائقا وهي الزئبق [و] اذا كانت بينهـــا نفس طاهرة مملت بها الرؤوس الكبار وذلت هيتك وبلغت مرادك وكنت سيدا ٭

خذ الفرار ان شئت ٭ والا فارض بالرق وصعد ذاك [c] بالزاج ٭ وحلل جسد الطلق
فان امت احياك ٭ فانت صاحب الحق وان احييت موتاك ٭ فانت سيد الخلق

والاصل التفريق ما بين الروح والنفس ثم تمويت النفس ثم رد الروح عليها حتى تحيـــا وتصير روحانية وتدخل في كل جسد فمن لم يفعل هكذا لم يظفر بطائل قال الحكيم

خذوا البدن المنقى فرضضوه ٭ وردوه الى لون بهيم بحر النار مجتهدين حتى ٭ يعود كميّت بال رميم
وذلك لا يكون بغير نار ٭ وتجربة من الفهم الحكيم الم تر اننا لاب وام ٭ ولون في نضارته وسيم
ولكن الهوا والشمس لما ٭ الحا بالحرارة والســـوم تغير بعضنا فاسود حتى ٭ كان سواده حمم الجحيم
كذلكم [d] [؟] الذي احرقتموه ٭ فسقّوه من الصافي الكريم فان الميت يحيا ثم [d] ... العود في الزهر العميم
فعنـــد حياته سقوه ماءً ٭ من الماء المهيّا بالسموم وتعطوه نحاسا ثم مسا ٭ منقى ليس بالمس الذميم
والقوا نصف وزنهما نحاسا ٭ خالصا غير مدخل [e] لئيم والقوا خمس وزنهما جميعا ٭ من البدن المراجع للنعيم

والكبريت او [f] الزئبق والزرنيخ الركنان العظيمان في الصنعة والركنان الباقيان النوشادر والفضة او الرصاص او الذهب او النحاس فاعرفوا ذلك واعملوا عليه ترشدوا ٭

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a) MS. ما شكلها b) MS. شبهها c) MS. ذلك d) MS. worm-eaten.
e) This line is faulty. f) MS. و

[*Chapter* II, 48½ *lines omitted.*]

باب ثالث في التحزيز والتدبير والتجزئة والتقدير * قال محمـــد بن عبد الملك الكاتي ان اقل ما يجب ان تاخذوا من هذه العقاقير حتى تجربوا منها ما شرحت في البابين من التدابير ذهب خالص ثلثة مثاقيل ونصف وهي خمسة دراهم ، وفضة خالصة اربعة دراهم ، ونحاس احمر خراساني خمس اواق وهي ثلثة وخمسون درهما ودانقان ، ونحاس موصلـــي درهم ، وروسختج [بصري [a] اوقية] وهي عشرة دراهم واربعة دوانق ، وزنجار حمصي ثلث اواق وهي اثنان وثلثون درهما ، وحديد نرماهن وهي الانثى سبع اواق وهي اربع وسبعون درهما واربعة دوانق ، وحديد فولاد وهو ذكر اوقيتان وهما [b] احد وعشرون درهما ودانقان ، و رصاص قلعي عشرة دراهم ، وزئبق احدى عشرة اوقية وهي مائة وسبعة عشر درهما [ودانقان [c]] ، وكبريت اصفر عراقي وتسع عشرة اوقية وسبعة دراهم وهي مائتان وتسعة دراهم واربعة دوانق ، [d] وزرنيخ اصفر افشيزق رطلان وثلث وهي مائتان [وثمانية [c]] وتسعـــون درهما واربعة دوانق ، وقلي عشرة ارطال لاربعة اواق ونصف ملح يعمل منه وهي الف ومائتان وثمانون درهما ، ونورة ثلث اواق وهي [اثنان و [c]] ثلثون درهما ، ونوشادر خراساني اوقيتان [e] [وستة دراهم [f]] وهي سبعـــة وعشرون درهما ودانقان ، وملح طيب رطلان [g] وهما مائتان وستة وخمسون درهما ، وزاج مصري خمس اواق وهي ثلثة وخمسون درهما ودانقان ، وقلقند ثلث اواق وهي اثنان وثلثون درهما ، واقليميا الذهب او مرقشيثا عشر اواق وهي مائة درهم وستة دراهم واربعة دوانق ، [h] ومغنيسيا انثى سوداء هشة رخوة ستة دراهم ، وشب يماني سبع اواق ونصف وهي ثمانون درهما ودانقان ، [i] وتنكار نصف اوقية وهي خمسة دراهم ودانقان ، ومرتك اوقية وهي عشرة دراهم واربعة دوانق ، وحجر مغناطيس ستة عشر قيراطا وهي درهم ودانقان ، وبورق ارمني احمر اوقيتيان [j] وهما احد وعشرون درهما ودانقان ، ونطرون ثمنية دراهم ودانقان ، وبيض دجاج خمسون [k] بيضة فذلك الجميع الفان وسبع مائة وثمانية وخمسون درهما ودانقان [l] وان احتجتم الى اكثر من هذه الادوية [m] فاضعفوا هذه الاوزان بالسوية ولا تزيدوا في حجر وتنقصوا من الاخر كي لا يفسد عليكم العمل و يفوتكم الاصل بل اذا زدتم في حجر زدتم بحساب ذلك من الاخر فاحفظوا القانون تظفروا بمرادكم وتبلغوا اقصى امانيكم وبغيتكم ان شاء الله تعالى *

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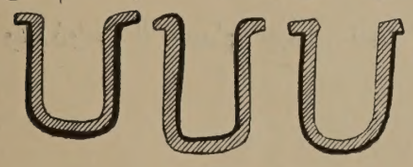
a) MS. worm-eaten : reading supplied from Chap. IV. *b*) MS. واوقيتين وهو *c*) Corrected from Chap. IV.
d) MS. وهي مائتان وثلث دراهم *e*) MS. اوقيتين *f*) MS. و نصف corrected by calculation from Chap IV.
g) MS. رطلين *h*) MS. مائة وثلث وخمسون درهما ودانقان : corrected by calculation.
i) The word دانقان should be omitted, but no change is made as the readings of Chaps. III. and IV. are identical.
j) MS. اوقتين *k*) MS. خمسين *l*) MS. وثلثة وخمسون درهما واربع دوانق *m*) MS. الدواء

[*Chapter* IV, 29 *lines omitted.*]

الباب الخامس في ذكر الالات وشرح ما [a] يحتاج اليه في البياض (والحمرة) [b] للشري والاعتراض * قال محمد بن عبد الملك الكاتي من ذلك مبرد لسحل [c] الفضة والنحاس والحديد وقدحان [d] من زجاج بلا بولين لتصعيد الفضة وصلاية حجر وفهر لسحق الادوية وخمس براني خزف مدهونة الدواخل باغطيتها للتشوية وثلثة قدور اثال طويلة [e] من خزف مدهونة الدواخل لتصعيد الرصاص وغيره وثلث مكبات خزف غير مدهونة لتغطية الاثال وقطعة منخل شعر لحل الرصاص وغيره وهو في اربعين يوما وقمع زجاج لفرش المنخل فيه ووضع ما يراد حله فوقه وقنينة كبيرة زجاج لتركيب القمع على فمها لينزل الدواء فيها وسلة ملبدة او قفص لتكب على القنينة لينحفظ في الزبل وهاون حجر لدق الكبريت وامثاله وقدح كبير لغسل الزئبق وبوطقة كبيرة وكور ومنفاخ وكلبتان [f] وماشك لاذابة الزئبق والزرنيخ ومرجل او طنجير لحل الشب وقوارير كالماوردیات للتخنيق [g] وقنينة كبيرة لحل الدواء كله وهو في ثلثة وثلثين يوما يكون جميع مدد الحل في باب الفضة ثلثة وسبعين [h] يوما سوى الايام التي تحصل فيها الادوية وتستعد للحل وبالله التوفيق * ذكر الآلات وما يحتاج اليه [i] في باب الحمرة للشري والخبرة * قال محمد بن عبد الملك من ذلك صلاية وفهر لسحق الزنجار والادوية المجموعة وبرنيتان كبيرتان [j] من خزف بغطائيهما [k] مدهونتا [l] الدواخل للتشوية [m] وهذا باب تدبير الركن الثاني الخ

[42 *lines omitted.*]

ثم تسحقوها وتاخذوا لها ثلث قدور الاثال وهي على هذه الصورة طول كل واحد منها عظم ذراع



Black
Red.
Fig. 9.

وفتحته شبر وشفته مقلوبة الى وراء بمقدار اربع اصابع مضمومة وهي من طين الغضاريين ومن عملهم مدهونة الدواخل وثلث مكبات خزف وهي غضار بلا كعاب محرقة غير مدهونة مثقوبة الجوانب من مواضع كعابها الى شفاهها باربع اصابع مضمومة ثقبا يدخله عود بغلظ المسلة لاستخراج الرطوبة منها واستعلام التصعيد بها وسعة شفاهها [n] على قدر سعة شفاه الاثال وان تعذرت فتاخذوا جاما من غضار

---

a) MS. اليها
b) This should probably be omitted, as the first list only comprises the instruments used in the preparation of silver.
c) MS. لمستحل
d) MS. وقد حين
e) MS. طويل
f) MS. وكلبتين
g) MS. للتحيق
h) MS. وسبعون
i) MS. اليها
j) MS. وبرنيتين كبيرتين
k) MS. باغطيتها
l) MS. مدهونة
m) Lacuna (?).
n) MS. شفاتها

و صاغرا وجرّة خضراء كبيرة او بستوقة تسع دورقين من الماء وزن الدورق الف واربعون درهما فتقطعوها نصفين بالمنشار وتاخذوا نصفها السفلاني حتى تجعلوا اثالا وتعملوا ترسا واسعا من طين الحكمة عرضه شبران وغلظه كعقد الابهام وتكبوا هذا النصف السفلاني من الجرة على وسط هذا الترس الرطب وتغمزوه فيه قليلا لتاخذوا مقدار سعته و يرتسم موضعه ثم ترفعوه ناحية وتاخذوا الجام الغضار وتكبوه على الترس ايضا وتغمزوه فيه لينحزّ موضعه ثم ترفعوه ناحية وتتركوا الترس في الفيء حتى يجف جفافا جيدا ثم تاخذوه وتقوّروا وسطه بالسكين الى حد علامة الجرة وتركبوه على فم [a] ذلك النصف السفلاني من الجرة وتاخذوا الوصل بينهما بالطين وتدعوه يجف عليه شبيها بشفاه الغضار [b] ويصير في صورة الاثال المستعمل ثم تاخذوه وتطينوا نصفه بطين الحكمة بعقد الابهام وتجعلوا له في حد النصف اربع ملازم من طين لقعوده على المستوقد وتجففوه ثم تبنوا له مستوقدا مدورا على عمل مستوقد الحلاويين له باب لطيف للوقود وكوة من يمينه وكوة من يساره على علو شكنكة من الارض للدخان وعلوه [c] من الارض شبران وفتحته ثلثة اشبار وتنصبوه على المستوقد على هذه الصورة

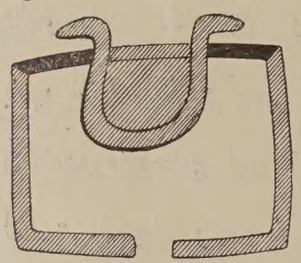


Fig. 10.

ويكون بين جوانبه وجوانب المستوقد من الفضاء مقدار اربع اصابع مضمومة للسان النار وبين اسفل القدر والارض فضاء بمقدار شبر وتستوثقوا من الوصل بينه وبين المستوقد بالتطيين حواليه وتاخذوا قليلا من اسفيداج الجص وتضربوه بالماء وتمسحوه على وجه شفته وتدعوه ثم ترشوا عليه [d] قليلا من ماء الملح وتصقلوه بمصقلة زجاج صقلا بالرفق حتى لاينكسر وتكبسوا فيه من الادوية التي يراد تصعيدها رطلين فحسب فالكثير يتنعر ولا يتصاعد ثم تاخذوا الجام الغضار وتثقبوا من جانبه في شفته الى الكعب بثلث اصابع ثقبا يدخله عود كالمسلة وتكبوه على الحزة التي في ترس الاثال على هذه الصورة

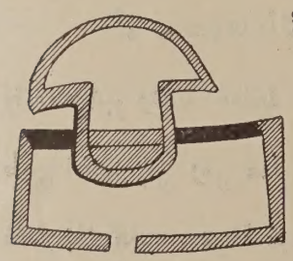


Fig. 11.

وتاخذوا من الاسفيداج المبلول قليلا وتصبوه حول الدرز . . . . . .

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a) MS. قر b) MS. بشفات الغضاري c) MS. وعلو d) MS. عليها

Fig. 4.

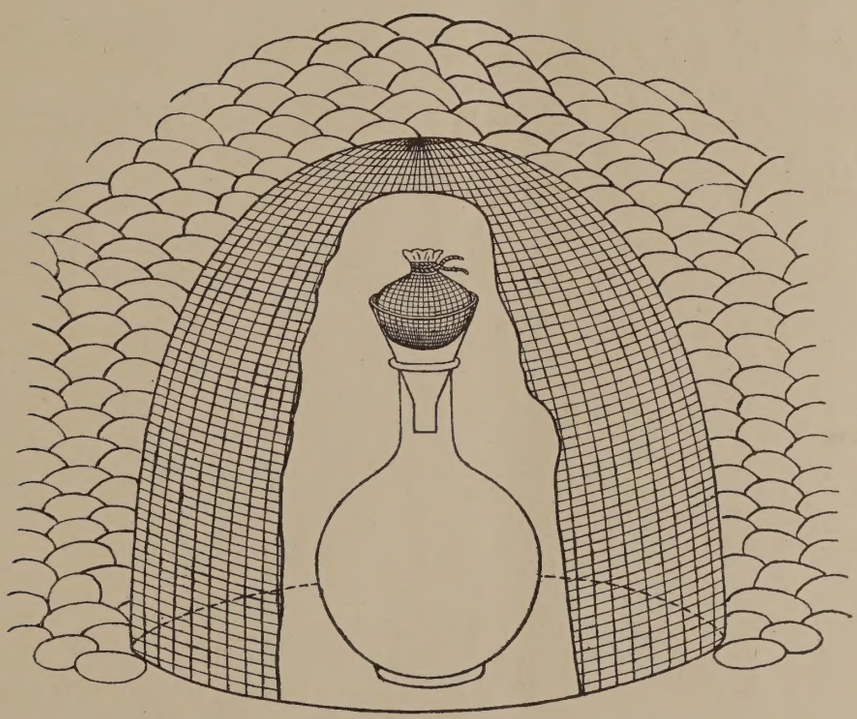

Fig. 5.

TWO METHODS OF CARRYING OUT THE PROCESS OF *HALL*.

[To face p. 61.]

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